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TITLE: LAP LASER WELDING METHOD

PUBN-DATE: June 19, 2001

INVENTOR-INFORMATION:

NAME	COUNTRY
TAKASAGO, TOSHIYUKI	
USUI, HIROTO	

ASSIGNEE-INFORMATION:

NAME	COUNTRY
TOYOTA MOTOR CORP	

APPL-NO: JP11347223
APPL-DATE: December 7, 1999

INT-CL (IPC): B23K 26/00

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PROBLEM TO BE SOLVED: To provide a lap laser welding method, in which a built-up zone for forming a minute gap for gas relief is easily formed for a steel plate.

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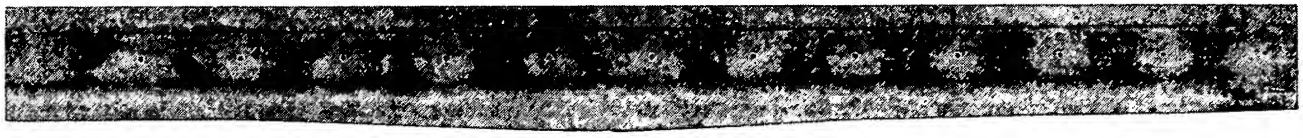

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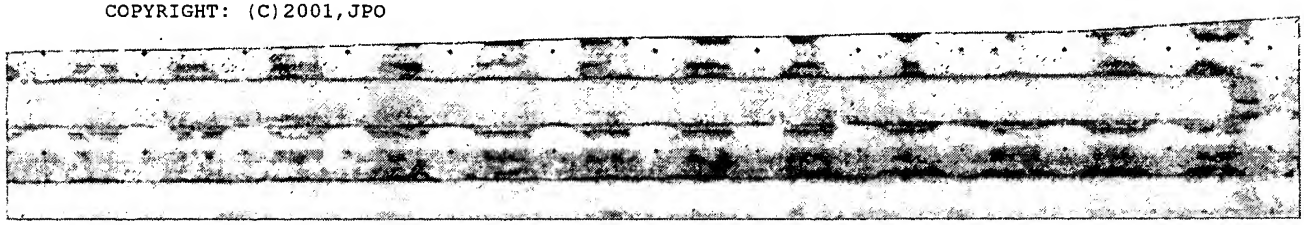

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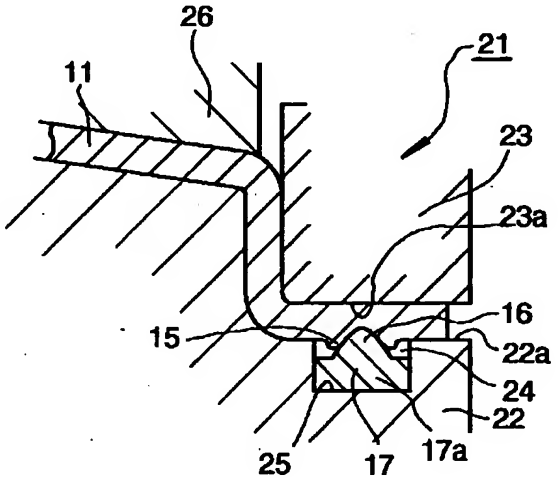
(54)【発明の名称】　重ねレーザ溶接方法

(57)【要約】
【課題】　ガス逃がし用の微小隙間を形成するための盛り上り部を鋼板に容易に形成することができる重ねレーザ溶接方法の提供。
【解決手段】　２枚の防錆鋼板１１、１２の重ねレーザ溶接であって、先端に凸形状部１６を有するポンチ１７により一方の鋼板１１の一面に圧印加工を施して、該一面の圧印部周囲に環状の盛り上り部１５および／または他面に山状の盛り上り部１５を形成し、一方の鋼板１１と他方の鋼板１２を盛り上り部１５による隙間１８をもたせて重ね合わせ、重ね合わせ部１９にレーザ溶接を施す、重ねレーザ溶接方法。



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【特許請求の範囲】

【請求項1】　2枚の防錆鋼板の重ねレーザ溶接方法であって、

先端に凸形状部を有するポンチの前記凸形状部により一方の鋼板の一面に圧印加工を施して、該一面の圧印部周囲に環状の盛り上り部および／または他面に山状の盛り上り部を形成し、

一方の鋼板と他方の鋼板を前記盛り上り部による隙間をもたせて重ね合せ、重ね合せ部にレーザ溶接を施す、重ねレーザ溶接方法。

【請求項2】　前記圧印加工が施される鋼板をプレス成形するプレス装置の、前記鋼板のレーザ溶接が施される部分を挟む2つの型のうち一方の型に、前記ポンチを、ポンチ先端を型表面から突出させ型に該突出ポンチ先端の周囲に型表面から後退した凹部を形成して、組み込んでおき、前記2つの型のうち他方の型の、前記ポンチに対向する面を平坦面としておき、前記圧印加工が施される鋼板のプレス成形時に該プレス成形と同時に、前記圧印加工が施される鋼板の前記2つの型で挟まれる部分に前記盛り上り部を形成する請求項1記載の重ねレーザ溶接方法。

【請求項3】　レーザ溶接すべき部位の長手方向と直交方向に、前記盛り上り部の中心と前記レーザ溶接すべき部位の中心との間隔が約3mm以内となり、かつ前記レーザ溶接すべき部位の長手方向と平行方向に、盛り上り部の中心間隔が約10mm以内、前記レーザ溶接すべき部位の端部と前記盛り上り部の中心との間隔が約5mm以内となるように、前記圧印加工が施される鋼板に対する前記ポンチの位置を決定する請求項1記載の重ねレーザ溶接方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、防錆鋼板（たとえば、亜鉛メッキ鋼板、メッキ鋼板のメッキ層の上にさらに樹脂をコーティングした複合鋼板等を含む）の重ねレーザ溶接方法に関する。

【0002】

【従来の技術】防錆鋼板、たとえば亜鉛メッキ鋼板を重ねレーザ溶接する場合、図10に示すように、鋼板11、12間のメッキ部11a、12aがレーザ熱で高圧のガス14となり（母材であるFeの融点は約1500℃であるのに対し、たとえば、亜鉛メッキに使用されるZnの沸点は約906℃）、溶接ビード13を吹き飛ばして吹き出すことがあり、その場合は溶接不良、溶接強度低下を招く。この溶接ビードを通しての高圧ガス吹き出しを抑制するには、鋼板間に微小隙間を設けて、メッキ金属がガス化して生じた高圧ガスを微小隙間を通して逃がすことが有効である。この微小隙間は、約0．4mm以上あると、溶接部がつながらず、また、約0．1mmより小だとガス逃がしが悪くなって溶接ビードを通しての高圧ガス吹き出しが生じやすくなるので、隙間を約0．1～0．4mmの範囲に管理することが必要である（トヨタ技術公開集No．9018）。重ねレーザ溶接される2枚の鋼板間に微小隙間を形成するには、従来、つぎのような、防錆鋼板の一方に隙間形成用の凸部を形成する方法、または2枚の板の形状を利用する方法などがある。

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①　エンボス加工

一方の型に凸部を形成し他方の型に該凸部と位置を合わせて凹部を形成しておき、型間に鋼板を挟んでプレスし、鋼板に凸部を成形する。

②　レーザスポット

特開平11－47967号公報に開示されているように、鋼板にレーザ光を照射して溶融池を作りそこにガスを吹き付けて溶融金属を溶融池の周りに押し出し環状の凸部を形成する。溶融池の部分は凹部となる。

③　板の打ち抜きばりあるいは断面R部の利用

鋼板の打ち抜きばりを凸部として利用する。あるいは湾曲断面の鋼板と直線断面の鋼板を重ねた場合に生じる板間隙間をガス逃げ用隙間として利用する。

【0003】

【発明が解決しようとする課題】しかし、上記の隙間形成方法にはつぎの問題があった。上記①のエンボス加工による凸部形成においては、上下型の凹凸を位置合わせするのが難しい。また、0．1～0．4mm程度の高さの微小凸部を作りだすことが難しく、凸部の寸法管理が困難である。上記②のレーザスポットによる凸部形成においては、レーザ照射により凹凸部を形成するため加工費が高い。また、1点ずつレーザ照射していくため時間もかかる。また、凸部形成のための工程が鋼板のプレス工程以外に必要となる。これらの結果、コストアップを招く。上記③の板の打ち抜きばりを利用した隙間形成方法においては、ばりの高さの管理が難しく隙間の寸法管理が困難である。また、断面Rの形状を利用して隙を作る場合は、レーザ光の照射位置が少しでもずれると、板間隙間の寸法が大きくく変化し、隙間の寸法管理が難しい。本発明の目的は、重ねレーザ溶接される防錆鋼板間にガス逃がし用の微小隙間を形成するための凸部を、重ねレーザ溶接される一方の鋼板に、容易に形成することができる重ねレーザ溶接方法を提供することにある。

【0004】

【課題を解決するための手段】上記目的を達成する本発明はつぎの通りである。

（1）　2枚の防錆鋼板の重ねレーザ溶接方法であって、先端に凸形状部を有するポンチの前記凸形状部により一方の鋼板の一面に圧印加工を施して、該一面の圧印部周囲に環状の盛り上り部および／または他面に山状の盛り上り部を形成し、一方の鋼板と他方の鋼板を前記盛り上り部による隙間をもたせて重ね合せ、重ね合せ部にレーザ溶接を施す、重ねレーザ溶接方法。

（2）　前記圧印加工が施される鋼板をプレス成形するプレス装置の、前記鋼板のレーザ溶接が施される部分を挟む2つの型のうち一方の型に、前記ポンチを、ポンチ先端を型表面から突出させ型に該突出ポンチ先端の周囲に型表面から後退した凹部を形成して、組み込んでおき、前記2つの型のうち他方の型の、前記ポンチに対向する面を平坦面としておき、前記圧印加工が施される鋼板のプレス成形時に該プレス成形と同時に、前記圧印加工が施される鋼板の前記2つの型で挟まれる部分に前記盛り上り部を形成する（1）記載の重ねレーザ溶接方法。

（3）　レーザ溶接すべき部位の長手方向と直交方向に、前記盛り上り部の中心と前記レーザ溶接すべき部位の中心との間隔が約3mm以内となり、かつ前記レーザ溶接すべき部位の長手方向と平行方向に、盛り上り部の中心間隔が約10mm以内、前記レーザ溶接すべき部位の端部と前記盛り上り部の中心との間隔が約5mm以内となるように、前記圧印加工が施される鋼板に対する前記ポンチの位置を決定する請求項1記載の重ねレーザ溶接方法。

【0005】上記（1）の重ねレーザ溶接方法では、ポンチによる圧印加工によって盛り上り部を形成するので、従来法に比べて容易かつ安価に盛り上りを形成することができる。上記（2）の重ねレーザ溶接方法では、2つの型のうちポンチを組み込まない方の型の、ポンチに対向する面を平坦面としておくので、ポンチ対向面に凹部を形成しておく場合（エンボス加工により盛り上り部を形成する場合）に比べて、ポンチの凸形状部と凹部との位置合わせが不要となり、盛り上り部形成が容易で安価になる。上記（3）の重ねレーザ溶接方法では、圧印加工が施される鋼板に対するポンチの位置が上記（3）の条件を満足することにより、すべての盛り上り部がレーザ溶接中に発生した高圧ガスを逃がすのに有効に働き、高品質なレーザ溶接を実行することができる。

【0006】

【発明の実施の形態】以下に、本発明実施例の重ねレーザ溶接方法を、図1～図9を参照して説明する。図1、図2に示すように、本発明実施例の重ねレーザ溶接は、2枚の防錆鋼板11、12の重ねレーザ溶接方法である。防錆鋼板11、12は、亜鉛等のメッキ鋼板（図1ではメッキ部を図示略、図2では11a、12aが鋼板11、12のメッキ部を示す）、またはメッキ鋼板の上に樹脂などを塗装した複合メッキ鋼板からなる。鋼板11、12は、たとえば、自動車用薄鋼板等として利用される。

【0007】本発明実施例の重ねレーザ溶接は、2枚の防錆鋼板11、12のうちの何れか一方の鋼板11に盛り上り部15を形成する工程と、2枚の防錆鋼板11、12を重ね合わせてレーザ溶接をする工程と、からなる。盛り上り部15を形成する工程では、図1に示すように、先端に凸形状部16を有するポンチ17の凸形状部16により一方の鋼板11の一面に圧印加工を施して、該一面の圧印部周囲に環状の盛り上り部15および／または他面に山状の盛り上り部15を形成する。凸形状部16の先端は、鋭角にすると摩耗が激しいので、平坦または凸状湾曲とされている。また、レーザ溶接工程では、図2に示すように、一方の鋼板11と他方の鋼板12を、盛り上り部15による隙間18をもたせて重ね合せ、重ね合せ部19にレーザ光20を照射してレーザ溶接を施す。

【0008】盛り上り部15を形成する工程では、図1に示すように、圧印加工が施される鋼板11をプレス成形するプレス装置21の、鋼板11のレーザ溶接が施される部分を挟む2つの型22、23のうち一方の型22に、ポンチ17を、ポンチ先端の凸形状部16の先端部を所定量型表面22aから突出させ型22に該突出ポンチ先端の周囲に型表面22aから後退した凹部24を形成して、組み込んでおき、2つの型22、23のうち他方の型23の、ポンチ17に対向する面23aは平坦面としておき、圧印加工が施される鋼板11のプレス成形時に該プレス成形と同時に、圧印加工が施される鋼板11の2つの型22、23で挟まれる部分に盛り上り部15を形成する。プレス成形と同時に盛り上り部15を形成することにより、盛り上り部15形成のために特別に余分の工程を設ける必要がなく、工程増、コストアップを招かない。

【0009】ポンチ17の型22への組み込みは、望ましくは、ポンチ17を型22と別体に形成しておいて、型22に形成したポンチ受入れ凹部25に挿入することによって行う。ただし、型22に一体にポンチ17の凸形状部16およびそのまわりの凹部24を形成してもよい。ポンチ17を型22と別体に形成しておいて、型22に形成したポンチ受入れ凹部25に挿入する場合は、ポンチ17は円筒部17aと凸形状部16を有し、円筒部17aは凸形状部16の外径より大の外径を有し、円筒部17aの高さはポンチ受入れ凹部25の深さより小の高さを有し、これによって円筒部17aの上方で凸形状部16のまわりに凹部24が形成されるようにする。

【0010】他方の型23のポンチ17対向部も、ポンチ受け部を型23と別体に形成しておき、型23に形成したポンチ受け部受入れ凹部に挿入するようにしてもよい。こうすることによって、他方の型23のポンチ17対向部の平坦面が、プレスによる盛り上り部15形成を重ねるうちに摩耗してきて凹状になった時に、容易にポンチ受け部だけを取り替えて平坦面を維持することができる。

【0011】プレス装置21は、下型22、上型である曲刃23、パッド26からなり、ポンチ17は下型22に組み込まれ、曲刃23のポンチ対向面を平坦面とした場合が示されている。ただし、ポンチ17が曲刃23に

組み込まれ、下型２２のポンチ対向面を平坦面としてもよい。

【００１２】レーザ溶接工程では、図２に示すように、２枚の鋼板１１、１２を重ね合わせて強く押さえる。Ｆは押え力である。この場合、一方の鋼板１１に盛り上り部１５が予め形成されているので、２枚の鋼板１１、１２間には盛り上り部１５の高さだけの隙間１８が形成される。隙間１８は、レーザ溶接時に２枚の鋼板１１、１２間に発生する高圧ガスを逃がす通路となる。この状態で、２枚の鋼板１１、１２の重ね合せ部１９にレーザ光２０を照射してレーザ溶接を施す。レーザ溶接は、盛り上り部１５によって２枚の鋼板１１、１２間に隙間１８が形成されている領域（盛り上り部１５からの距離が大になり過ぎると型２１、２２によって押されている鋼板１１、１２が互いに接触し隙間が無くなるので、盛り上り部１５からの距離が所定距離以内で鋼板１１、１２間に隙間が存在する領域）に施される。この領域でレーザ溶接が施されると、鋼板１１、１２のメッキ１１ａ、１１ｂがレーザ溶接の熱でガス化して高圧ガスが発生しても、隙間１８を通って外部に逃げるので、溶接ビードを吹き飛ばして表面側に吹き出すことがなく、正常なレーザ溶接ビード１３が形成され、溶接強度が確保される。

【００１３】レーザ溶接２０が、盛り上り部１５によって２枚の鋼板１１、１２間に隙間１８が形成されている領域に施されるために、圧印加工が施される鋼板１１に対するポンチ１７の位置は、図９に示すように、決定される。すなわち、レーザ溶接すべき部位２７（溶接後、溶接ビード１３となる部位）の長手方向と直交方向に、盛り上り部１５の中心とレーザ溶接すべき部位２７の中心との間隔が約３ｍｍ以内となり、かつレーザ溶接すべき部位２７の長手方向と平行方向に、盛り上り部１５の中心間隔が約１０ｍｍ以内で、レーザ溶接すべき部位２７の端部と盛り上り部１５の中心との間隔が約５ｍｍ以内となるように、ポンチ１７の位置が決定される。

【００１４】

【実施例】盛り上り部１５の成形荷重を把握する試験を行った。図３に試験装置を示す。盛り上り部１５を形成すべき亜鉛メッキ鋼板１１からなるワークを、下型２２の上に配置したスペーサ２８およびポンチ１７と、上型２３との間に挟み、ワーク１１に盛り上り部１５を形成した。ポンチ１７は凸形状部１６、円筒部１７ａ、基礎部１７ｂを有し、ポンチ１７の円筒部１７ａまわりにスペーサ２８を配置し、凸形状部１６の上端部がスペーサ２８の上端より０．８ｍｍ突出するセットした。ポンチ１７は台２９で支持し、台２９をウレタンの筒体３０で支持して図示略の下型２２上に配置した。

【００１５】試験仕様はつぎの通りであった。

ポンチの凸形状部のテーパ角度：９０°および６０°の２種類のポンチを使用した。

ポンチの円筒部と凸形状部との高さ：１０ｍｍ

スペーサ高さ：９．２ｍｍ。ポンチの円筒部と凸形状部との高さ－スペーサ高さ＝０．８ｍｍがスペーサからのポンチ先端部突出量となる。

荷重＝６００ｋｇ

鋼板板厚＝１．０ｍｍ

ポンチの個数ｎ＝１

【００１６】試験結果を図４に示す。図４において、縦軸は試験後の板厚（元板厚１ｍｍ＋ポンチ接触側の盛り上り部の高さａ＋それと反対側の盛り上り部の高さｂ）で横軸はかけた荷重６００ｋｇまでを１００ｋｇ間隔で示す。図４には、ポンチ角が６０°の場合と９０°の場合の試験結果をプロットしてそれを折れ線の実線で結んだものを示してあり、破線は各折れ線の平均を線型の直線で示したものである。図５、図６はポンチ角が９０°で、荷重Ｆが６００ｋｇの場合のワークの表裏面の形状測定を０．２ｍｍピッチで行った結果を示している。図６はポンチ接触側と反対側の面を示したもので０．１ｍｍ以上の山状の盛り上り部が形成されていることがわかる。また、図５はポンチ接触側の面を示したもので、ポンチで押された部分が約０．８ｍｍ凹みその周囲が盛り上がったクレータ状の凹凸となっていることがわかる。そしてクレータ状の凹凸の盛り上り部の高さはポンチ接触側と反対側の面の盛り上り部の高さよりは低かった。

【００１７】図４、図５、図６より、板厚増加量（ワーク表裏面の盛り上り部の高さの和）は０．０６～０．１５ｍｍであり、０．１ｍｍ程度のワークの表裏面の盛り上り部の高さの和を形成することは圧印加工で可能であり、その場合盛り上り部１個につき約３００ｋｇ程度以上の荷重が必要であることがわかった。鋼板成形のためのプレス装置の荷重容量はそれより数十倍以上あるから、従来のプレス装置にポンチを組み込んでプレス成形と同時に圧印加工を施すことが可能であることもわかった。

【００１８】また、ワークの表裏面の盛り上り部の高さの和が０．１ｍｍ程度ある場合、ワーク表裏で盛り上り部の高さに差があるので、片側面で約０．０７ｍｍ以上の盛り上り部の高さが得られる。そして、片側面に０．０７ｍｍの盛り上り部を形成した１ｍｍ厚亜鉛メッキ鋼板を平坦な亜鉛メッキ鋼板と重ねあわせてレーザ溶接を施したところ、溶接ビードの吹き飛ばしの無い良好な溶接ビードが得られた。このことから、メッキ高圧ガス逃がし用に２枚の防錆鋼板間の隙間として従来必要と考えられていた「０．１ｍｍ以上」の条件は「０．０７ｍｍ以上」であればよいことがわかった。

【００１９】つぎに、良好な（高圧ガスによるビード吹き飛ばしのない）溶接ビード１３が得られるための、盛り上り部１５とレーザ溶接すべき部位２７との位置関係についての試験を行った。盛り上り部１５を形成した亜鉛メッキ鋼板１１の試験片を無作為に１０個選び、盛り上り部高さ（ワーク表裏面の盛り上り部高さの和）を測

定したところ０．１０mm～０．１３mmの範囲にあり、単純平均で０．１２mmであった。

【００２０】図7に、溶接ビード１３の中心から１mm、２mm、３mm、４mmの距離でビード中央に位置するように盛り上り部１５を形成した場合の重ね合わせレーザ溶接の結果を示し、図８に溶接ビード１３から２mmの距離で、中央から７．５mmおよび１２．５mmの位置に盛り上り部１５を形成した場合の重ね合わせレーザ溶接の結果を示す。斜線の部分は目視で溶接ビードに荒れが見られた部分である。図7および図８より、溶接ビード１３の荒れ防止に有効な盛り上り部１５形成領域は、溶接ビード１３（溶接すべき部位２７）の中心から、約３mm以内であり、溶接ビード長手方向に盛り上り部１５の効果は盛り上り部１５から約５mmまでであることがわかった。図９に有効領域の範囲を示した。ただし、上記３mm、５mmは、平板の限定された板厚についてのデータであり、あくまで目安の数字であり、実験は効果があることを実証したに過ぎない。

【００２１】

【発明の効果】請求項１の重ねレーザ溶接方法によれば、ポンチによる圧印加工によって盛り上り部を形成するので、従来法に比べて容易かつ安価に盛り上りを形成することができる。請求項２の重ねレーザ溶接方法によれば、２つの型のうちポンチを組み込まない方の型の、ポンチに対向する面を平坦面としておくので、ポンチ対向面に凹部を形成しておく場合（エンボス加工により盛り上り部を形成する場合）に比べて、ポンチの凸形状部と凹部との位置合わせが不要となり、盛り上り部形成が容易で安価になる。請求項３の重ねレーザ溶接方法によれば、レーザ溶接すべき部位の長手方向と直交方向に、盛り上り部の中心とレーザ溶接すべき部位の中心との間隔が約３mm以内となり、かつレーザ溶接すべき部位の長手方向と平行方向に、盛り上り部の中心間隔が約１０mm以内、レーザ溶接すべき部位の端部と盛り上り部の中心との間隔が約５mm以内となるように、圧印加工が施される鋼板に対するポンチの位置を決定するので、すべての盛り上り部がレーザ溶接中に発生した高圧ガスを逃がすのに有効に働き、高品質なレーザ溶接を実行することができる。

【図面の簡単な説明】

【図１】本発明実施例の重ねレーザ溶接方法の、盛り上り部形成工程の、断面図である。

【図２】本発明実施例の重ねレーザ溶接方法のレーザ溶接工程の、断面図である。

【図３】圧印加工試験に用いた装置の断面図である。

【図４】圧印加工の、板厚対荷重の関係を示すグラフである。

【図５】圧印加工後ワーク表面を粗さ計で測定した時の、ワークのポンチ接触側の表面の凹凸図である。

【図６】圧印加工後ワーク表面を粗さ計で測定した時の、ワークのポンチ接触側と反対側の表面の凹凸図である。

【図７】盛り上り部とレーザ溶接すべき部位（溶接ビードとなる部位）の位置関係を変化させた場合のと溶接ビードの荒れ発生状態を示す図である。

【図８】盛り上り部とレーザ溶接すべき部位（溶接ビードとなる部位）の位置関係を変化させた場合のと溶接ビードの荒れ発生状態を示す図である。

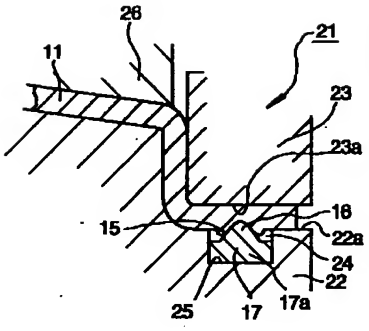
【図９】良好な溶接ビードが得られるための、盛り上り部とレーザ溶接すべき部位との位置関係の条件を示す図である。

【図１０】従来の重ねレーザ溶接方法の、溶接ビード近傍の、断面図である。

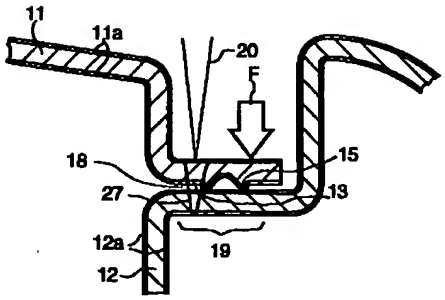
【符号の説明】

１１　防錆鋼板
１１ａ　メッキ部
１２　防錆鋼板
１２ａ　メッキ部
１３　溶接ビード
１４　高圧ガス
１５　盛り上り部
１６　凸形状部
１７　ポンチ
１７ａ　円筒部
１７ｂ　基礎部
１８　隙間
１９　重ね合わせ部
２０　レーザ光
２１　プレス装置
２２　下型
２３　上型
２４　凹部
２５　ポンチ受入れ凹部
２６　パッド
２７　レーザ溶接すべき部位
２８　スペーサ
２９　台
３０　ウレタン筒体

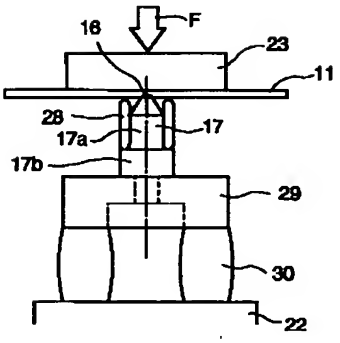
【図１】



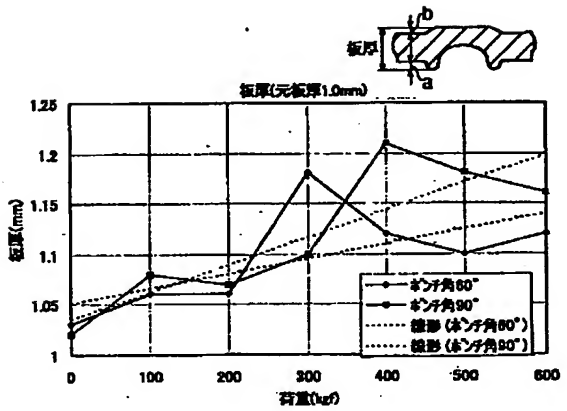
【図２】



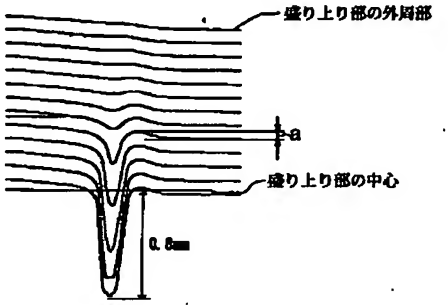
【図３】



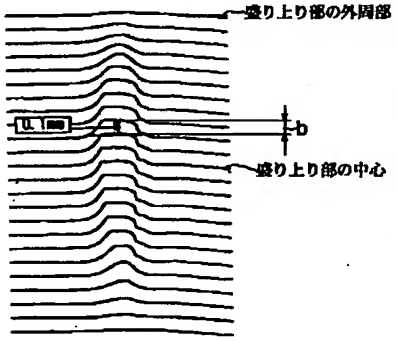
【図４】



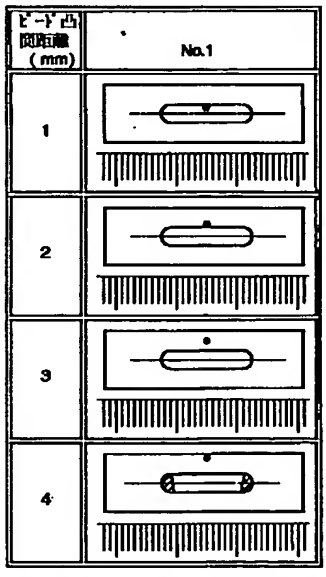
【図５】



【図６】

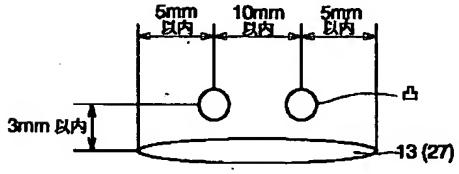


【図７】

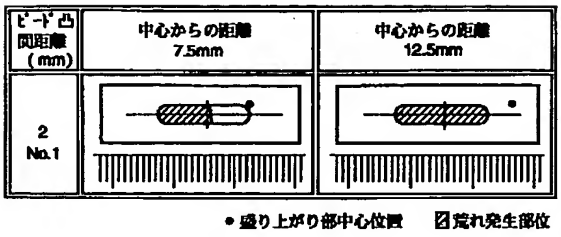


● 盛り上がり部中心位置　▨ 荒れ発生部位

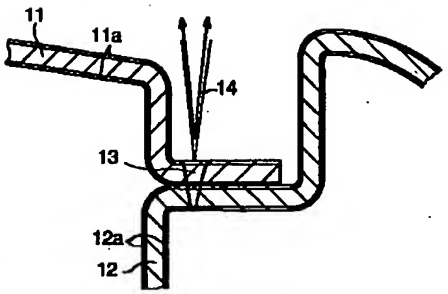
【図９】



【図8】


ビード凸
間距離
（mm）
中心からの距離
7.5mm
中心からの距離
12.5mm
2
No.1
● 盛り上がり部中心位置
荒れ発生部位

【図10】


11
11a
14
13
12a
12

CLAIMS

[Claim(s)]

[Claim 1] Are the heavy laser welding method of the rustproof steel plate of two sheets, and it ********s on the whole surface of one steel plate by said convex configuration part of the punch which has a convex configuration part at a tip. The heavy laser welding method of giving and piling up the climax part and/or the crevice forming a ****-like climax part on the other hand, and according one steel plate and the steel plate of another side to said climax part annular to the circumference of ****** between these whole surface, and performing laser welding to a superposition part.

[Claim 2] Between two molds which sandwich the portion to which laser welding of said steel plate of the press equipment which carries out press forming of the steel plate with which said coining is performed is performed, [one mold] The crevice which the punch tip was made to project from the mold surface, and retreated said punch from the mold surface around this tip of projection punch in the mold is formed. Incorporate and the field which counters said punch of the mold of another side while of said two types is made into the flat side. The heavy laser welding method according to claim 1 which forms said climax part in the portion pinched with said two molds of the steel plate with which said coining is performed at the time of press forming of the steel plate with which said coining is performed simultaneously with this press forming.

[Claim 3] In the longitudinal direction and the rectangular direction of a part which should be carried out laser welding, the gap of the center of said climax part and said center of a part which should be carried out laser welding is set to less than about 3mm. And [the longitudinal direction and parallel direction of said part which should be carried out laser welding / the center interval of a climax part] so that a gap with the center of less than about 10mm, and the end of said part which should be carried out laser welding and said climax part may be set to less than about 5mm The heavy laser welding method according to claim 1 of determining the

position of said punch to the steel plate with which said coining is performed.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the heavy laser welding method of a rustproof steel plate (for example, the compound steel plate which coated resin further on the metal skin of a galvanized steel sheet and a plating steel plate is included).

[0002]

[Description of the Prior Art] As shown in drawing 10 when piling up and carrying out laser welding of a rustproof steel plate, for example, the galvanized steel sheet A steel plate 11, the plating part 11a between 12, and 12a become high-pressure gas 14 with laser heat ([the melting point of Fe which is a base material / as opposed to / being about 1500 degrees C]). The boiling point of Zn used for galvanization may blow away about 906 degrees C and the weld bead 13, may blow off, and causes a poor weld and welding strength reduction in that case. In order to control high pressure gas blow off which lets this weld bead pass, it is effective to prepare an infinitesimal gap between steel plates and to miss the high pressure gas which plating metal gasified and produced through an infinitesimal gap. Since a weld zone will not be connected if there is about 0.4mm or more of this infinitesimal gap, and it becomes easier to produce high pressure gas blow off for which gas ** lets a weld bead pass by worsening in ** in case of smallness than about 0.1mm It is required to manage a crevice in the range of about 0.1-0.4mm (Toyota technical public presentation collection No.9018). In order to form an infinitesimal gap between the steel plates of two sheets by which heavy laser welding is carried out, there is a method of forming the convex part for crevice formation in following one side of a rustproof steel plate conventionally or a method of using the form of two boards.

** A convex part is formed in embossing one mold, and this **** and a position are doubled with the mold of another side, form the crevice, press on both sides of a steel plate between molds, and fabricate a convex part to a steel plate.

** Laser light is irradiated at a steel plate, and a molten pool is made, spray gas there, extrude melting metal around a molten pool, and form an annular convex part as indicated by laser spot JP,H11-47967,A. The portion of a molten pool serves as a crevice.

** Use punch **** of a board, or punch **** of the use steel plate of the cross-sectional R section as a convex part. Or between the board gaps produced when the steel plate of a curve section and the steel plate of a straight line section are piled up is used as a crevice for gas escape.

[0003]

[Problem to be solved by the invention] However, there was the following problem in the above-mentioned crevice formation method. In the **** formation by embossing of the above-mentioned **, it is difficult to carry out position doubling of the fluctuated type unevenness. Moreover, it is difficult to make minute **** about 0.1-0.4mm high, and the dimensional control of a convex part is difficult. In the **** formation by the laser spot of the above-mentioned **, in order to form a concavo-convex part by laser radiation, a conversion cost is high. Moreover, in order to carry out laser radiation of every one point, it also takes time. Moreover, the process for **** formation is needed for except for the press operator of a steel plate. These results cause a cost hike. In the crevice formation method of having used punch **** of the board of the above-mentioned **, management of the height of **** is difficult and the dimensional control of a crevice is difficult. Moreover, when making spare time using the form of Section R and the radiation position of laser light shifts, the size between board gaps ****** greatly and the dimensional control of a crevice is difficult. The purpose of this invention is to offer the heavy laser welding method which heavy laser welding of while is carried out, and can form easily in a steel plate the convex part for gas ** carrying out and forming the infinitesimal gap of business between the rustproof steel plates by which heavy laser welding is carried out.
[0004]
[Means for solving problem] This invention which attains the above-mentioned purpose is as follows.
(1) Are the heavy laser welding method of the rustproof steel plate of two sheets, and ******** on the whole surface of one steel plate by said convex configuration part of the punch which has a convex configuration part at a tip. The heavy laser welding method of giving and piling up the climax part and/or the crevice forming a ****-like climax part on the other hand, and according one steel plate and the steel plate of another side to said climax part annular to the circumference of ****** between these whole surface, and performing laser welding to a superposition part.
(2) The press equipment which carries out press forming of the steel plate with which said coining is performed, The crevice which the punch tip was made to project from the mold surface in one mold, and retreated said punch from the mold surface around this tip of projection punch in it at the mold between two molds which sandwich the portion to which laser welding of said steel plate is performed is formed. Incorporate and the field which counters said punch of the mold of another side while of said two types is made into the flat side. said -- coining -- giving -- having -- a steel plate -- press forming -- the time -- this -- press forming -- simultaneously -- said -- coining -- giving -- having -- a steel plate -- said -- two -- a ** -- a mold -- inserting -- having -- a portion -- said -- climax -- a part -- forming -- (-- one --) -- a description -- a pile -- laser welding -- a method .
(3) In the longitudinal direction and the rectangular direction of a part which should be carried

out laser welding, the gap of the center of said climax part and said center of a part which should be carried out laser welding is set to less than about 3mm. And [the longitudinal direction and parallel direction of said part which should be carried out laser welding / the center interval of a climax part] so that a gap with the center of less than about 10mm, and the end of said part which should be carried out laser welding and said climax part may be set to less than about 5mm The heavy laser welding method according to claim 1 of determining the position of said punch to the steel plate with which said coining is performed.
[0005] By the heavy laser welding method of the above (1), since it rises by coining by punch and a part is formed, compared with a conventional method, climax can be formed easily and inexpensive. Since the field which counters the punch of the mold of the direction which does not incorporate punch between two molds by the heavy laser welding method of the above (2) is made into the flat side Compared with the case (when rising by embossing and forming a part) where the crevice is formed in the punch opposed face, position doubling of the convex configuration part of punch and a crevice becomes unnecessary, and climax part formation is easy and becomes inexpensive. When the position of the punch to the steel plate with which coining is performed is satisfied with the heavy laser welding method of the above (3) of the conditions of the above (3), it can work effective in all the climax parts missing the high pressure gas which occurred during laser welding, and quality laser welding can be performed.

[0006]
[Mode for carrying out the invention] Below, the heavy laser welding method of this invention example is explained with reference to drawing 1 - drawing 9 . As shown in drawing 1 and drawing 2 , the heavy laser welding of this invention example is the rustproof steel plate 11 of two sheets, and the heavy laser welding method of 12. The rustproof steel plate 11 and 12 consist of a compound plating steel plate which painted resin etc. on plating steel plates (11a and 12a show a plating part by drawing 1 , and show a steel plate 11 and the plating part of 12 by illustration abbreviation and drawing 2), such as zinc, or a plating steel plate. A steel plate 11 and 12 are used as sheet steel for cars etc., for example.
[0007] the process which the heavy laser welding of this invention example rises to the rustproof steel plate 11 of two sheets, and the steel plate 11 of either of 12, and forms a part 15, the rustproof steel plate 11 of two sheets and the process which piles up 12 and carries out laser welding, ** and others -- ** the climax part 15 with this whole surface annular to the circumference of ****** which ********s on the whole surface of one steel plate 11 by the convex configuration part 16 of punch 17 which has the convex configuration part 16 at a tip as the process which forms the climax part 15 shows to drawing 1 -- and/or, on the other hand, the ****-like climax part 15 is formed. Since wear is intense when it is made an acute angle, the tip of the convex configuration part 16 is considered as flatness or a convex curve. Moreover, at a

laser welding process, as shown in drawing 2 , the crevice 18 according one steel plate 11 and the steel plate 12 of another side to the climax part 15 is given and piled up, the laser light 20 is irradiated and laser welding is performed to the superposition part 19.

[0008] The press equipment 21 which carries out press forming of the steel plate 11 with which coining is performed at the process which forms the climax part 15 as shown in drawing 1 , Two molds 22 which sandwich the portion to which laser welding of a steel plate 11 is performed, and among 23, [one mold 22] The crevice 24 which the tip part of the convex configuration part 16 at the tip of punch was made to project from the specified quantity type surface 22a, and retreated punch 17 from the mold surface 22a around this tip of projection punch in the mold 22 is formed. Incorporate and two molds 22 and the field 23a which counters the punch 17 of the mold 23 of another side among 23 are made into the flat side. At the time of press forming of the steel plate 11 with which coining is performed, it rises into two molds 22 of the steel plate 11 with which coining is performed, and the portion pinched by 23, and, simultaneously with this press forming, a part 15 is formed. It is not necessary to establish an excessive process specially because of climax part 15 formation, and the increase of a process and a cost hike are not caused by rising simultaneously with press forming and forming a part 15.

[0009] Desirably, inclusion in the mold 22 of punch 17 forms punch 17 in the mold 22 and another object, and is performed by inserting in the punch acceptance crevice 25 formed in the mold 22. However, you may form the convex configuration part 16 of punch 17, and the crevice 24 around it in a mold 22 at one. When inserting in the punch acceptance crevice 25 which forms punch 17 in the mold 22 and another object, and was formed in the mold 22 Punch 17 has the cylinder part 17a and the convex configuration part 16, and the cylinder part 17a has an adult outer diameter from the outer diameter of the convex configuration part 16. The height of the cylinder part 17a has the height of smallness from the depth of the punch acceptance crevice 25, and a crevice 24 is formed in the surroundings of the convex configuration part 16 of this in the upper part of the cylinder part 17a.

[0010] You may make it insert in the punch receptacle part acceptance crevice it the punch 17 opposite part of the mold 23 of another side also forms the punch receptacle part in the mold 23 and another object, and formed in the mold 23. When it is worn out while the flat side of the punch 17 opposite part of the mold 23 of another side repeated the climax part 15 formation by a press, and it becomes a concave by carrying out like this, only a punch receptacle part can be exchanged easily and a flat side can be maintained.

[0011] Press equipment 21 consists of **** 23 and the pad 26 which are a bottom part 22 and a punch, punch 17 is built into a bottom part 22, and the case where the punch opposed face of **** 23 is made into a flat side is shown. However, punch 17 is built into **** 23 and it is good also considering the punch opposed face of a bottom part 22 as a flat side.

[0012] At a laser welding process, as shown in drawing 2 , the steel plate 11 of two sheets and 12 are piled up, and it presses down strongly. F is control power. In this case, since it rises to one steel plate 11 and the part 15 is formed beforehand, it rises between the steel plate 11 of two sheets, and 12, and the crevice 18 only between the height of a part 15 is formed. A crevice 18 serves as a passage which misses the steel plate 11 of two sheets, and the high pressure gas which occurs among 12 at the time of laser welding. In this state, the laser light 20 is irradiated and laser welding is performed to the steel plate 11 of two sheets, and the superposition part 19 of 12. Laser welding is a field (since a mold 21, the steel plate 11 pushed by 22, and 12 will contact mutually and a crevice will be lost, if the distance from the climax part 15 becomes size too much) where the crevice 18 is formed between the steel plate 11 of two sheets, and 12 of the climax part 15. Distance from the climax part 15 is given to a steel plate 11 and the field to which a crevice exists among 12 within predetermined distance. Since it will escape outside through a crevice 18 even if a steel plate 11, the plating 11a of 12, and 11b gasify with the heat of laser welding and high pressure gas occurs if laser welding is performed in this field A weld bead is blown away, it does not blow off to the surface side, the normal laser welding bead 13 is formed, and welding intensity is secured.

[0013] Since laser welding 20 is performed to the steel plate 11 of two sheets, and the field to which the crevice 18 is formed among 12 by the climax part 15, the position of the punch 17 to the steel plate 11 with which coining is performed is determined as shown in drawing 9 . In namely, the longitudinal direction and the rectangular direction of a part 27 (part which serves as the weld bead 13 after welding) which should be carried out laser welding A gap with the center of the part 27 which should be carried out laser welding to the center of the climax part 15 is set to less than about 3mm, and the center interval of the climax part 15 to the longitudinal direction and in parallel of a part 27 it should carry out laser welding within about 10mm The position of punch 17 is determined so that it may rise with the end of the part 27 which should be carried out laser welding and a gap with the center of a part 15 may be set to less than about 5mm.

[0014]

[Working example] The examination which grasps the forming load of the climax part 15 was done. A testing device is shown in drawing 3 . The work which consists of a galvanized steel sheet 11 which should form the climax part 15 was inserted between the spacer 28 and punch 17 which have been arranged on a bottom part 22, and a punch 23, it rose to the work 11, and the part 15 was formed. punch 17 has the convex configuration part 16, the cylinder part 17a, and the basic part 17b, and arranges a spacer 28 to the circumference of the cylinder part 17a of punch 17, and the upper limit part of the convex configuration part 16 projects 0.8mm from the upper limit of a spacer 28 -- it set. Punch 17 was supported on the stand 29 and has been arranged on the bottom part 22 of illustration abbreviation in support of a stand 29 with the

cylinder 30 of urethane.

[0015] The examination specification was as follows.

The degree of taper angle of the convex-configuration part of punch: Two kinds of punch, 90 degrees and 60 degrees, was used.

Height:10mm spacer height which it is with the cylinder part of punch, and a convex-configuration part: 9.2mm. Height-spacer height of the cylinder part of punch, and a convex configuration part = 0.8mm becomes the amount of punch tip part projection from a spacer. Load =600kg steel plate board thickness = The number n= 1 of 1.0mm punch [0016] A test result is shown in drawing 4. In drawing 4 , a vertical axis shows even 600kg of load over which the horizontal axis was covered at intervals of 100kg by the board thickness after an examination (height a+ of the climax part by the side of 1mm of former board thickness + punch contact height [of the climax part of it and the opposite side] b). What plotted the test result in the case of being the case where a punch angle is 60 degrees, and 90 degrees in drawing 4 , and connected it with the solid line of the polygonal line to it is shown, and a dashed line shows the average of each polygonal line in a line type straight line. A punch angle is 90 degrees and drawing 5 and drawing 6 show the result of having performed shape measuring of the rear surface side of a work in case Load F is 600kg in the 0.2mm pitch. Drawing 6 is what showed the field of the opposite side the punch contact side, and it turns out that the climax part of the shape of a mountain of 0.1mm or more is formed. Moreover, drawing 5 is what showed the field by the side of punch contact, and it turns out that it is unevenness of the shape of a crater in which the portion pushed to punch was dented about 0.8mm, and the circumference rose. And the height of the climax part of crater-like unevenness was lower than the height of the climax part of the field of the punch contact side and the opposite side.

[0017] Board thickness augend (sum of the height of the climax part of a work rear surface side) is 0.06-0.15mm from drawing 4 , drawing 5 , and drawing 6 . It is possible to form the sum of the height of the climax part of the rear surface side of an about 0.1mm work at coining, and it turned out in that case that about 300kg or more per climax part of load is required. Since there was tens of or more times load capacity of the press equipment for steel plate fabrication from it, it was understood that it is also possible to build punch into conventional press equipment and to ******** simultaneously with press forming.

[0018] Moreover, since the sum of the height of the climax part of the rear surface side of a work rises by a work rear surface about 0.1mm in a certain case and a difference is in the height of a part, the height of climax part of about 0.07mm or more is obtained in respect of one side. And when the 1mm thickness galvanized steel sheet in which the 0.07mm climax part was formed to the single-sided side was piled up with the flat galvanized steel sheet and laser welding was performed, the good weld bead where a weld bead blows and which does not have ****** was obtained. Things understood the conditions of "0.1mm or more" which

plating ********** carried out and were considered from this to be conventionally required as a crevice between the rustproof steel plates of two sheets by business that what is necessary is just "0.07mm or more."

[0019] the examination about physical relationship with the part 27 which should be carried out laser welding to the climax part 15 to obtain the good (for it to be based on high pressure gas -- for there to be bead ********** as for nothing) weld bead 13 next was done. Ten test pieces of the galvanized steel sheet 11 in which the climax part 15 was formed were chosen at random, when climax part height (sum of the climax part height of a work rear surface side) was measured, it was in the range of 0.10mm - 0.13mm, and it was 0.12mm in the arithmetic average.

[0020] The result of the superposition laser welding at the time of rising to drawing 7 so that it may be located in the center of a bead in the distance of 1mm, 2mm, 3mm, and 4mm from the center of the weld bead 13, and forming a part 15 in it is shown, and to drawing 8 [weld bead / 13 / the distance of 2mm] The result of the superposition laser welding at the time of rising in position of 7.5mm and 12.5mm from a center, and forming a part 15 is shown. The portion of a slash is a portion as which roughness was visually regarded by the weld bead. From the center of the weld bead 13 (part 27 which should be welded), climax part 15 formation area effective in rough prevention of the weld bead 13 is less than about 3mm, and rose to the weld bead longitudinal direction, and drawing 7 and drawing 8 showed that the effect of a part 15 was from the climax part 15 to about 5mm. The range of an effective area was shown in drawing 9 . However, the 3 above-mentionedmm and 5mm were data about the limited monotonous board thickness, and it is the number of a standard to the last, and it was proved that an experiment was effective.

[0021]

[Effect of the Invention] Since according to the heavy laser welding method of Claim 1 it rises by coining by punch and a part is formed, compared with a conventional method, climax can be formed easily and inexpensive. Since the field which counters the punch of the mold of the direction which does not incorporate punch between two molds is made into the flat side according to the heavy laser welding method of Claim 2 Compared with the case (when rising by embossing and forming a part) where the crevice is formed in the punch opposed face, position doubling of the convex configuration part of punch and a crevice becomes unnecessary, and climax part formation is easy and becomes inexpensive. [according to the heavy laser welding method of Claim 3] in the longitudinal direction and the rectangular direction of a part which should be carried out laser welding A gap with the center of the part which should be carried out laser welding to the center of a climax part is set to less than about 3mm. And so that the center interval of a climax part may rise less than about 10mm with the end of the part which should be carried out laser welding to the longitudinal direction and

parallel direction of the part which should be carried out laser welding and a gap with the center of a part may be set to less than about 5mm at them Since the position of the punch to the steel plate with which coining is performed is determined, it can work effective in all the climax parts missing the high pressure gas which occurred during laser welding, and quality laser welding can be performed.

[Translation done.]